PLUG CONNECTION DEVICE

FIELD OF THE INVENTION

The invention relates to a plug connection device and, more particularly, to a plug connection device that includes a receiving element with at least one opening for receiving a contact pin wherein a surface of the contact pin is connected to an inner surface of the receiving element.

BACKGROUND OF THE INVENTION

Conventional plug connection devices are used in the production of electronic components and comprise a receiving element having a housing with at least one opening for receiving a contact pin. When mated, a surface of the contact pin is connected, at least in certain sections, to an inner surface of the receiving element. The housing is typically an insulative plastic housing, such as, a header, and the contact pin is conductive and typically made from, for example, a drawn wire. The housing and/or the contact pin have machining marks that extend substantially in a longitudinal direction, i.e., parallel to a mating direction, that are formed during production. Because of the method of production of the contact pin and the housing, when the drawn wire is mated with the plastic housing, shavings are formed. The shavings are only a few hundredths of a millimeter thick, however, the shavings can

attain a length that is sufficient to bridge adjacent contact pins positioned in the housing, which may result in a short circuit.

SUMMARY OF THE INVENTION

It is, therefore, an object of the invention to provide a plug connection device that prevents the occurrence of short circuits between adjacent contact pins.

This and other objects are achieved by a plug connection device comprising a contact pin and a receiving element. The contact pin has an outer surface. The receiving element has openings. Each of the openings has an inner surface that contacts the outer surface of the contact pin when the contact pin is received therein. The plug connection device has grooves extending in a radial direction. A distance between adjacent grooves is smaller than a distance between adjacent openings.

This and other objects are further achieved by contact pins for a plug connection device wherein each of the contact pins has an outer surface with contact pin grooves extending in a radial direction. A distance between adjacent contact pin grooves is smaller than a distance between adjacent contact pins.

This and other objects are still further achieved by a receiving element for a plug connection device comprising

openings with an inner surface. The inner surface has receiving element grooves extending in a radial direction. A distance between adjacent grooves is smaller than a distance between adjacent openings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of a first embodiment of a contact pin;

Fig. 2 is a plan view of a second embodiment of the contact pin;

Fig. 3 is a plan view of a third embodiment of the contact pin; and

Fig. 4 is a sectional view of a receiving element.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows a first embodiment of a contact pin 1 of a plug connection device according to the invention. The contact pin 1 may be, for example, a terminal of an electrical component. The contact pin 1 is made from an electrically conductive material, such as, for example, tin, and has machining marks 2 and contact pin grooves 4 formed on a outer surface 3 thereof. For sake of clarity, the contact pin grooves 4 and the machining marks 2 shown in the figures have been exaggerated. The machining marks 2 are formed in a longitudinal direction, which corresponds to a mating

direction. The machining marks 2 are formed during production of the contact pin 1. The contact pin 1 may be formed, for example, from drawn metal wire that may be cut to length for cost efficiency. In the illustrated embodiment, the contact pin 1 is elongated in shape and circular in cross-section for ease of mating with a receiving element 5, shown in Fig. 4. Other embodiments of the contact pin 1, however, are possible. For example, the contact pin 1 may be square or oval-shaped. The machining marks 2 are removed in a region of the contact pin grooves 4, in order to reduce shaving formation. Because the contact pin 1 is formed from a metal, such as, tin, etc., production of the contact pin 1 is cost-efficient and good electrical conductivity is ensured.

The contact pin grooves 4 are formed after cutting the pin contact 1 to length, for example, by engraving or rolling, and are formed to extend transversely to the mating direction. The contact pin grooves 4 extend further in a radial direction than in the longitudinal direction. The contact pin grooves 4 are formed to be larger than any surface unevenness (not shown) of the contact pin 1 to reduce shaving formation. The contact pin grooves 4 are set apart from one another and extend parallel to one another and encircle the contact pin 1 to further reduce shaving formation. The distance of the contact pin groove 4 from the end sections of the contact pin 1, and the distance between adjacent contact pin grooves 4, should be shorter than

the distance between adjacent openings 6 of the receiving element 5, to be discussed later.

Fig. 2 shows a second embodiment of the contact pin 1 according to the invention. For ease of description, components identical to the first embodiment will not be further described herein, and identical components are designated with identical reference numerals. As shown in Fig. 2, the second embodiment differs from the first embodiment in that the contact pin grooves 4 of the second embodiment have an angular form and are inclined with respect to the longitudinal direction of the contact pin 1 to reduce shaving formation. The contact pin grooves 4 may be inclined by, for example, 45 degrees to further reduce shaving formation.

Fig. 3 shows a third embodiment of the contact pin 1 according to the invention. For ease of description, components identical to the first and second embodiments will not be further described herein, and identical components are designated with identical reference numerals. As shown in Fig. 3, the third embodiment differs from the first and second embodiments in that the contact pin grooves 4 of the third embodiment have a teardrop shape and are mutually offset relative to each other. This configuration reduces shaving formation.

Fig. 4 shows the receiving element 5 of a plug connection device according to the invention. The receiving element 5 may

be, for example, a circuit board. The receiving element 5 is made from a non-conductive material, such as, plastic or other polymer, to protect against short circuits and to ensure that production is cost-efficient. The receiving element 5 has an opening 6 corresponding to a shape of the contact pin 1 to facilitate insertion therein. The opening 6 may be, for example, a conventional circular opening or an oval or polygonal opening. The opening 6 has a diameter slightly larger than a diameter of the contact pin 1. On an inner surface 8 of the receiving element 5 and extending in a longitudinal direction are machining marks 7. The machining marks 7 correspond to a mating direction and are produced when the opening 6 is formed in the receiving element 5. The opening 6 may be produced, for example, by punching. Although only one of the openings 6 is shown in Fig. 4, the receiving element 5 may have a plurality of openings 6, set apart from one another. One of the contact pins 1 is associated with each of the openings 6.

As shown in Fig. 4, the receiving element 5 has receiving element grooves 9 extending in a radial direction. For sake of clarity, the receiving element grooves 9 and the machining marks 7 have been exaggerated. The receiving element grooves 9 extend transversely to the mating direction. Similar to the contact pin 1, the machining marks 7 on the receiving element 5 are removed in a region of the receiving element grooves 9.

Each of the receiving element grooves 9 is larger than any surface unevenness (not shown) of the receiving element 5 to reduce shaving formation, and the receiving element grooves 9 extend further in the radial direction than in the longitudinal direction to further reduce shaving formation. The receiving element grooves 9 encircle the receiving element 5, and a plurality of the receiving element grooves 9 are set apart from one another and extend parallel to one another. The distance of the receiving element groove 9 from an end section of the receiving element 5, and the distance between adjacent receiving element grooves 9, should be shorter than the distance between adjacent openings 6 of the receiving element 5, in order to effectively prevent short circuits. Similar to the contact pin 1, the grooves may be inclined, in certain sections, by, for example, 45 degrees with respect to the longitudinal direction of the receiving element 5. The receiving element grooves 9 may also have an angular form or a tear-dropped shape.

Assembly and operation of the plug connection device will now be described in greater detail. The contact pin 1 is plugged into the opening 6 of the receiving element 5. In the plugged-in state, the outer surface 3 of the contact pin 1 is connected, at least in certain sections, to the inner surface 8 of the receiving element 5. The contact pin 1 protrudes partially beyond the receiving element 5. Because the surface

of the contact pin 1 and/or the inner surface 8 of the receiving element 5 comprises at least one of the contact pin grooves 4 or the receiving element grooves 9 that extends in a radial direction, shaving formation is effectively reduced. If a shaving is produced, the shaving will break in a region of one of the contact pin grooves 4, 9. Because the length of the shaving is controlled, the shaving will remain shorter than the distance between adjacent openings 6. Bridging of neighboring contact pins 1 by the shavings is thereby avoided, reducing the occurrence of short circuits.